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PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

TO PCT

To: ROBERT C. SCHEINFELD
BAKER BOTTS LLP
30 ROCKFELLER PLAZA
NEW YORK NY 10112-0228

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

	Date of Mailing *(day/month/year)* 29 DEC 2000
Applicant's or agent's file reference 32717-PCT	**FOR FURTHER ACTION** **See paragraphs 1 and 4 below**
International application No. PCT/US00/26997	International filing date *(day/month/year)* 29 SEPTEMBER 2000
Applicant IMS HEALTH INCORPORATED	

1. [X] The applicant is hereby notified that the international search report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the international search report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Docketed

For more detailed instructions, see the notes on the accompanying sheet. For 2 / 28 /2001 By

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in rules 90 *bis* 1 and 90 *bis* 3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer JAMES TRAMMEL Peggy Harrod
Facsimile No. (703) 305-3230	Telephone No. (703) 305-9768

(See notes on accompanying sheet)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 32717-PCT	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/US00/26997	International filing date *(day/month/year)* 29 SEPTEMBER 2000	(Earliest) Priority Date *(day/month/year)* 30 SEPTEMBER 1999
Applicant IMS HEALTH INCORPORATED		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (See Box II).

4. With regard to the **title**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

[ ] the text is approved as submitted by the applicant.

[X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 2

[ ] as suggested by the applicant.

[X] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

Techniques for estimating the impact of one or more promotions on product performance for a product are disclosed. In a preferrred embodiment, a method is presented which involves determining market events which may impact product performance. The market events are examined to detect any abnormal event and, if abnormal events are detected, generating a description for each detected for abnormal event. A relationship between each promotion and the product is then determined, and a promotion lag structure between the promotions and product performance is systematically detected. (See figure 2, items 210, 220, 230, 240) Functional forms are selected to account for any impact of the determined market events which may impact product performance, and are evaluated to account for the determined market event. The relationship between the promotions and product performance is quantified by taking into account the selected functional forms. (See figure 2, item 270)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/26997

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G 06 F 17/60
US CL : 705/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

STN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	US 6,035,284 A (STRAUB et al) 07 March 2000, abstract, figure 1, figure 7b, column 1, lines 32-45	1-17
Y, P	US 6,029,139 A (CUNNINGHAM et al) 22 February 1999 abstract, figure 1, figure 2, column 1, lines 19-34, 59-63	1-17

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 NOVEMBER 2000	29 DEC 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JAMES TRAMMEL Telephone No. (703) 305-9768

Form PCT/ISA/210 (second sheet) (July 1998)★

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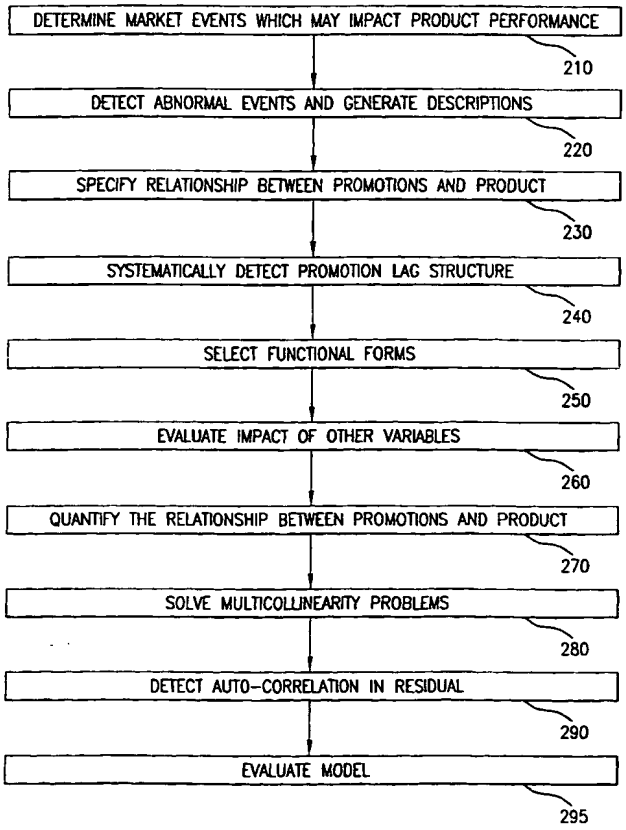
(54) Title: A PROMOTIONAL IMPACT ASSESSMENT METHODOLOGY



(57) Abstract: Techniques for estimating the impact of one or more promotions on product performance for a product are disclosed. In a preferred embodiment, a method is presented which involves determining market events which may impact product performance. The market events are examined to detect any abnormal event and, if abnormal events are detected, generating a description for each detected for abnormal event. A relationship between each promotion and the product is then determined, and a promotion lag structure between the promotions and product performance is systematically detected (items 210, 220, 230, 240). Functional forms are selected to account for any impact of the determined market events which may impact product performance, and are evaluated to account for the determined market event. The relationship between the promotions and product performance is quantified by taking into account the selected functional forms (item 270).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A PROMOTIONAL IMPACT ASSESSMENT METHODOLOGY

SPECIFICATION

RELATED APPLICATION

The present application is based on U.S. provisional patent application serial number 60/157,139, filed September 30, 1999, from which priority is claimed.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is related to statistically measuring the impact of promotions on product sales, and more particularly, to techniques which employ time series analysis as part of an estimation methodology to determine such impact.

2. Related Art

Pharmaceutical companies spend billions of dollars each year to promote prescription drugs using various promotional vehicles. These include sales representatives detailing physicians about the information of their products and dropping free samples in doctors office, advertising in medical journals, continuing education programs for physician, and Direct-to-Consumer (DTC) advertising. With such financial and personnel investment, pharmaceutical companies need to measure the return on investment in prescription drug promotions. To do this, the impact of various promotions on product performance must be quantified.

Unfortunately, measuring the impact of promotions separately from other market inputs is not a simple task, as numerous factors may influence product performance. Moreover, it is well known that promotions have lagged effect, i.e., adverting activities in this month may increase prescription volume or market share for the product in next month, and the effect may last for several months. To accurately estimate the promotional effects, this lag structure must be evaluated. This is a very complicated problem because many forms of promotions may happen at the same time

and each of them may have different lag structure. Furthermore, the promotion lag structures vary across products and across therapeutic classes. The fact that many market inputs other than promotions, such as price, product attributes, and the entry of competitive products, may impact product performance further complicates the detection of the promotional lag structure.

Time series analysis is one well-known econometric tool that has been applied to study the relationship between advertising and sales. G. E. P. Box and G. M. Jenkins in their book, "Time Series Analysis: Forecasting and Control," San Francisco: Holden-Day, Inc. (1976), laid down the theoretical foundation of time series analysis and Box-Jenkins transfer function analysis. R. M. Helmer and J. K. Johansson applied the Box-Jenkins transfer function analysis to studying the advertising-sales relationship using a vegetable compound data, see "An Exposition of the Box-Jenkins Transfer Function Analysis With an Application to the Advertising-Sales Relationship," Journal of Marketing Research, 227-239 (1977). In their article, the procedural steps in applying the transfer function analysis technique are specified and applied to the sample advertising-sales data with particular focus on the advertising lag structure.

In the article "The Impact of a Direct-to-Consumer Prescription Medication Advertising Campaign on New Prescription Volume," Drug Information Journal, Vol. 30, 715-729 (1996), L. R. Basara used the new prescription data of a newly launched prescription drug and the Direct-to-Consumer advertising data constructed a time-series regression model with lagged sales and a first-order moving-average residual. However, the methodologies in these articles failed to account for other market events and market inputs such as competitive product launches, additional indications approved, and product price. In the book W. H. Greene, "Econometric Analysis," Prentice-Hall, Inc. (1997), a comprehensive discussion of different functional forms of lagged effect is provided. The disclosures of the Box et. al., Helmer et al., Basara and Greene references are incorporated by reference herein.

While the use of time series analysis techniques in assessment of the impact of advertising on product sales is discussed in each of the forgoing articles and books, none of the prior articles' or books' techniques disclose a methodology for systematically assessing the impact of promotional activity on product performance while

taking into account other market variables. Accordingly, there exists a need in the art for a broad and accurate promotional impact assessment technique.

SUMMARY OF THE INVENTION

An object of the present invention is to provide improved techniques for statistically measuring the impact of promotions on product sales.

A further object of the present invention is to provide improved techniques which employ time series analysis as part of an estimation methodology to determine the impact of promotions on product sales.

Yet another object of the present invention is to provide promotion response methodology for systematically assessing the impact of promotional activity on product performance while taking into account other market variables.

In order to achieve these objectives as well as others that will become apparent with reference to the following specification, the present invention provides techniques for estimating the impact of one or more promotions on product performance for a product are disclosed. In a preferred embodiment, a method is presented which involves determining market events which may impact product performance. The market events are examined to detect any abnormal event and, if abnormal events are detected, generating a description for each detected abnormal event. A relationship between each promotion and the product is then determined, and a promotion lag structure between the promotions and product performance is systematically detected. Functional forms are selected to account for any impact of the determined market events which may impact product performance, and are evaluated to account for the determined market event. The relationship between the promotions and product performance is quantified by taking into account the selected functional forms.

In one arrangement, the product is a pharmaceutical product, and the market event determining step involves manually determining one or more pharmaceutical market events which may impact pharmaceutical product performance. The abnormality examining step is then statistically determining whether any of the pharmaceutical market events is an abnormal event and, if one or more abnormal events are detected, generating statistical descriptions for each detected abnormal event.

In an especially preferred arrangement, the promotion lag detection step involves fitting a univariate auto-regressive model to each promotion to determine one or more promotion residual series, regressing performance information for the product to determine a product residual, transforming the product residual into a product residual series, determining one or more cross-correlation functions between the promotion residual series and product residual series, plotting the cross- correlation functions to detect any lagged effect from the promotions corresponding to those functions, and selecting appropriate functional form which best fit the plotted functions.

The accompanying drawings, which are incorporated and constitute part of this disclosure, illustrate a preferred embodiment of the invention and serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a functional diagram of a system in accordance with a preferred embodiment of the present invention;

Fig. 2 is a flow diagram illustrating the basic steps implemented in the system of Fig. 1;

Fig. 3 is a flow diagram illustrating the steps that may be implemented in one arrangement of a cross-correlation function useful in the system of Fig. 1; and

Fig. 4 is a flow diagram illustrating the steps that may be implemented in one arrangement of a functional form evaluation useful in the system of Fig. 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

In general, the present invention adapts and expands upon certain time series analysis techniques so that the impact of any promotional activities on product performance can be determined. In particular, cross-correlation functions are used to systematically detect promotion lag structure, and different functional forms are used to account for other market inputs in the model. While as exemplary embodiment of the present invention will be described herein to estimate the number of new prescriptions of a product that are attributable to DTC advertising, the approach has general applicability to study the impact of other forms of promotions such as professional detailing, sampling,

and medical journal advertising, continuing medical educational events and meetings on product sales.

The present invention applies to studying the promotional impact on increasing both primary and secondary demand. To determine the impact on primary demand, the prescription volume for the therapeutic class is used as the outcome variable. To determine the impact on secondary demand, product market share is used as the outcome variable.

Referring to Fig. 1, one preferred arrangement of the present invention requires the execution of several logical steps, each of which are discussed below. All steps may be performed either manually or on a system 100 including a computer 110 executing standard off the shelf statistical software, such SAS® or EViews. It should be noted that the following description is by way of example and not by limitation, with certain embodiments being described in order to best explain the principles of the present invention.

Referring next to Fig. 2, the logical steps implemented in the preferred arrangement will be described with reference to the flow diagram 200. In step 210, the market events that may impact product performance, such as the arrival of new approved indications, the launch of competitive products, any positive or negative publicity, policy changes and the like, are identified. This step may be performed manually by a research analyst who is familiar with the particular market in the pharmaceutical industry.

In step 220, any abnormalities in the data collected by the research analyst are detected, and descriptive statistics for each variable under study are generated. For example, off the shelf statistical software may be used to check the data collected by the data analyst to determine whether an abnormal number of prescriptions occurred in a time period to flag a probable human error. The descriptive statistics, such as the mean, standard deviation, minimum and maximum quantities are calculated for each of the variables under study. This step is required to ensure the quality of the data.

In step 230, the model structure of multiplicative or additive which reflects the relationships between promotions and product prescription data to be multiplicative or additive is specified by the research analyst. The research analyst may repeat the analysis for both multiplicative and additive model structures and then select the better

model based on the modeling fitting information, the reasonableness of the coefficients estimates, and model robustness to changes in specification.

In step 240, a cross-correlation function is used to systematically detect promotion lag structure. Referring to Fig. 3, a highly preferred arrangement of step 240 is further discussed.

First, an univariate auto-regressive model is fit to the promotion data "X" in 310, as fully described in the Box et al. article. This fitting is performed to remove the trend and seasonal components from the promotion variable. The model structure and the coefficients will be used in later steps. The residual series is called XX.

Second, the prescription data Y is regressed on variables which are known to have impact on product performance 320, such as trend, new product launch, new indication approved, and the like, to determine the residual of Y. Any standard multiple regression algorithm may be used, such as PROC REG in SAS®. This regression is implemented to remove the impact of other market events on the prescription data.

Third, the model structure and coefficients estimated from the first sub-step are used 330 to transform the residual series of prescription data Y generated in 320 to determine a new residual series, YY.

Fourth, the cross- correlation function between the residual series XX determined in 310 and the residual series YY determined in 330 is calculated 340. The detailed definition of cross-covariance and cross-correlation is fully described in the Box and Jenkins book which provides that the estimation of cross – covariance of Y and X is:

$$C_{XY}(k)=\frac{1}{N}\sum_{t=1}^{N-k}(X_t-\overline{X})(Y_{t+k}-\overline{Y})\ k=...,-1,0,1,2,... \qquad (1)$$

where t is the time period, N is total number of time periods, k is number of time periods between X and Y, $\overline{X}$ is the mean of X, $\overline{Y}$ is the mean of Y. The estimation of cross – correlation of Y and X is:

$$r_{XY}(k)=C_{XY}(k)/S_X S_Y \quad k=...,-1,0,1,2,... \qquad (2)$$

where

$$S_X=\sqrt{C_{XX}(0)} \text{ and } S_Y=\sqrt{C_{YY}(0)}$$

Fifth, $r_{XY}(k)$ is plotted on one axis and k on the other axis to plot the cross correlation function 350, which is examined to detect the initial lag and the length of lagged effect. The time period when the cross correlation function starts to increase/decrease is the time period the promotional effect starts, i.e. the initial lag. The time period when the cross correlation function reduces to a low level indicates the time period the promotion effect disappeared, the difference between the time period of the initial lag and the time period when the effect disappeared is the length of the promotion lagged effect. This provides an initial assessment of the lag structure.

Finally, different functional forms, such as the Polynomial Distributed Lag, or the Geometric distributed lag as described in the WH Greene reference, are fit to the data 360. The functional form which best fits the data is chosen by comparing the models, as well as the sign and significance of the coefficients of the variables in the models.

Returning to Fig. 2, in step 250, appropriate functional forms to account for other market events, such as new product launch, new indications approved, positive/negative publicity, etc., are evaluated. Referring to Fig. 4, a highly preferred arrangement of step 250 is further discussed.

First, the prescription data is plotted against time to examine the temporal pattern of the data 410. The data may be plotted using prescription data as the vertical axis and time as the horizontal axis.

Second, based on the plotted data, a functional form is selected 420. At the time of the market event under consideration, such as a new product launch or new indication approval, or shortly after, if the prescription data exhibits shift in trend, marked by a changing slope:

$$M(t) = \begin{cases} 0, & t < T \\ t, & t \geq T \end{cases} \qquad (3)$$

where T is the time of the market event, either M(t) is included as an independent variable in the model , or the interaction between M(t) and the trend variable is included as an independent variable in the model , with the model producing a smaller residual being selected.

Likewise, if the prescription data exhibits a jump, marked by a discontinuity:

$$M(t) = \begin{cases} 0, & t < T \\ 1, & t \geq T \end{cases} \quad (4)$$

either M(t) is included as an independent variable in the model , or the interaction between M(t) and the trend variable is included as an independent variable in the model , with the model producing a smaller residual being selected.

Finally, residual of the model and the coefficient estimate are examined 430 to determine whether the T is correctly specified. Since some market input may have lagged effect, a small integer such as 1, 2 or 3 may need to be added to T to account for the lag. A big residual at time T indicates a problematic model fit. The pattern of the residual will suggest the choice of the T. For example, if there are big residuals for two time periods after T, the T should increase by two time periods.

In step 260, the impact on prescription data of other variables such as product price, managed care impact, and the like, are evaluated, using the steps specified in step 240, by an analyst to determine whether the other variables are also impacting the prescription data and the lag structure.

In step 270, the multiplicative or additive models specified in step 230 are fit to quantify the relationship between prescription variables and promotion variables, and other market events and market inputs.

In step 280, multicollinearity problems between independent variables are checked. Some variables may have to be dropped due to the multicollinearity problem.

In step 290, the model residual is evaluated to detect any auto-correlation in residual. If there is auto-correlation in the residual, an autoregressive structure for the residual should be included in the model.

Finally, in step 295, the model is evaluated and validated to examine the stability and reasonableness of the model coefficients. For example, the model may be tested using the next several months of data to validate the model. The model estimates of the variables are applied to the next several months of data to compute sales, and are compared actual sales.

As described above, one advantage of the present invention is to combine econometric modeling techniques with transfer function analysis techniques in time series

analysis to detect the lag structure, and to quantify the effects of various promotions controlling for the impact of other factors. Using time series data of promotions and other key market inputs, this methodology can isolate and quantify promotional effects on products' prescription share and the total therapeutic class prescription volume. This methodology is applicable to measuring a wide range of promotional effects including DTC, professional detailing, sampling, and medical journal spending, and continuing medical educational events and meetings while controlling factors known to influence market share such as prescription price, competitive product launch, new indication approved, positive/negative publicity etc. Without accounting for the impact of these factors appropriately, it would not be possible to accurately measure the incremental prescriptions attributable to promotions.

Previous work done by Helmer and Johansson, and Basara applied the transfer function analysis to studying the promotional lagged effect, but failed to account for other market events and market inputs such as new product launches, new indications approved, positive/negative publicity, product price. As stated previously, this may result in inaccurate estimates of the promotional effects. Others accounted for some of the market inputs but relied on past experience and a "trail and error" approach to detect the promotional lag structure. The "trail and error" approach is time consuming and past experience may result in biased estimates because past experience may not be applicable to new promotional vehicles.

The foregoing merely illustrates the principles of the invention. Various modifications and alterations to the described embodiments will be apparent to those skilled in the art in view of the teachings herein. For example, this methodology may be modified to analyze the sales and promotions and other market inputs for consumer packaged goods. It will thus be appreciated that those skilled in the art will be able to devise numerous systems and methods which, although not explicitly shown or described herein, embody the principles of the invention and are thus within the spirit and scope of the invention.

CLAIMS

1. A method for estimating the impact of one or more promotions on product performance for a product, comprising the steps of:

a. determining one or more market events which may impact said product performance;

b. examining said determined one or more market events to detect any abnormal event and, if one or more abnormal events are detected; generating a description for each detected abnormal event;

c. determining a relationship between each of said one or more promotions and said product;

d. systematically detecting a promotion lag structure between said one or more promotions and said product performance for said product;

e. selecting one or more functional forms to account for any impact of each of said one or more determined market events which may impact said product performance;

f. evaluating each of said selected functional forms to account for said one or more determined market events, and

g. quantifying a relationship between said one or more promotions and said product performance for said product by taking into account said evaluated selected functional forms.

2. The method of claim 1, further comprising the step of checking for any multicollinearity problems between said one or more promotions, said product performance, and said evaluated selected functional forms.

3. The method of claim 2, wherein said relationship between said one or more promotions and said product performance includes a quantified portion and a residual portion, and further comprising the step of evaluating said residual portion to detect auto-correlation.

4. The method of claim 3, further comprising the step of evaluating and validating said quantified relationship.

5. The method of claim 1, wherein said product is a pharmaceutical product, and said market event determining step comprises manually determining one or more pharmaceutical market events which may impact said pharmaceutical product performance.

6. The method of claim 5, wherein said abnormality examining step comprises statistically determining whether any of said one or more pharmaceutical market events is an abnormal event and, if one or more abnormal events are detected; generating statistical descriptions for each detected abnormal event.

7. The method of claim 6, wherein said relationship determining step comprises determining a relationship between each of said one or more promotions and said product to be a relationship selected from the group consisting of multiplicative, additive, or other.

8. The method of claim 1, wherein said promotion lag detection step comprises:

(a) fitting a univariate auto-regressive model to each of said one or more promotions to determine one or more promotion residual series;

(b) regressing performance information for said product to determine a product residual;

(c) transforming said product residual into a product residual series;

(d) determining one or more cross- correlation functions between said one or more promotion residual series and said product residual series;

(e) plotting said one or more cross- correlation functions to detect any lagged effect from said one or more promotions corresponding to said one or more cross- correlation functions; and

(f) selecting one or more appropriate functional form which best fits said plotted functions.

9. The method of claim 1, wherein said functional form selection step comprises:

(a) plotting pharmaceutical product sales verses time to determine any temporal relationship; and

(b) selecting said functional form by examining said plotted data.

10. The method of claim 1, wherein said functional form evaluation step comprises graphical evaluation.

11. A system for estimating the impact of one or more predetermined promotions on product performance for a product by taking into account one or more predetermined market events which may impact said product performance, comprising:

a. means for examining said predetermined one or more market events to detect any abnormal event and for generating a description for each detected abnormal event, if any;

b. means for determining a relationship between each of said one or more predetermined promotions and said product;

c. means, responsive to said abnormality descriptions generated by said abnormality examining means and said determined relationships from said relationship determining means , for systematically detecting a promotion lag structure between said one or more promotions and said product performance for said product based on said abnormality descriptions and said determined relationships;

d. means, responsive to said predetermined market events , for selecting one or more functional forms to account for any impact of each of said one or more predetermined market events which may impact said product performance;

e. means, responsive to said selected functional forms generated by

said selection means, for evaluating each of said selected functional forms to account for said one or more determined market events, and

f. means, responsive to said detected promotion lag structure and evaluated selected functional forms, for quantifying a relationship between said one or more promotions and said product performance for said product by taking into account said promotion lag structure and evaluated selected functional forms.

12. The system of claim 11, further comprising means, responsive to said quantified relationships, for checking for any multicollinearity problems between said one or more promotions, said product performance, and said evaluated selected functional forms.

13. The system of claim 11, wherein said relationship between said one or more promotions and said product performance includes a quantified portion and a residual portion, and further comprising means, responsive to said quantified relationships, for evaluating said residual portion to detect auto-correlation.

14. The system of claim 11, further comprising means, responsive to said quantified relationships, for evaluating and validating said quantified relationship.

15. The system of claim 11, wherein said product is a pharmaceutical product, and said abnormality examining means includes means for statistically determining whether any of said one or more pharmaceutical market events is an abnormal event.

16. The system of claim 11, wherein said promotion lag detection means further includes:

(a) means for fitting a univariate auto-regressive model to each of said one or more promotions to determine one or more promotion residual series;

(b) means for regressing performance information for said product to determine a product residual;

(c) means, responsive to said product residual determined by said regressing performance means, for transforming said product residual into a

product residual series;

(d) means, responsive to said product residual series transformed by said transforming means and to said promotion residual series determined by said fitting means, for determining one or more cross- correlation functions between said one or more promotion residual series and said product residual series;

(e) means, responsive to said one or more cross- correlation functions determined by said cross-correlation function determining means, for plotting said one or more cross- correlation functions to detect any lagged effect from said one or more promotions corresponding to said one or more cross- correlation functions; and

(f) means, responsive to said plotting means, for selecting one or more appropriate functional form which best fits said plotted functions.

17. The system of claim 11, wherein said functional form selection means includes:

(a) means for plotting pharmaceutical product sales verses time to determine any temporal relationship; and

(b) means, responsive to said plotting means, for selecting said functional form by examining said plotted data.

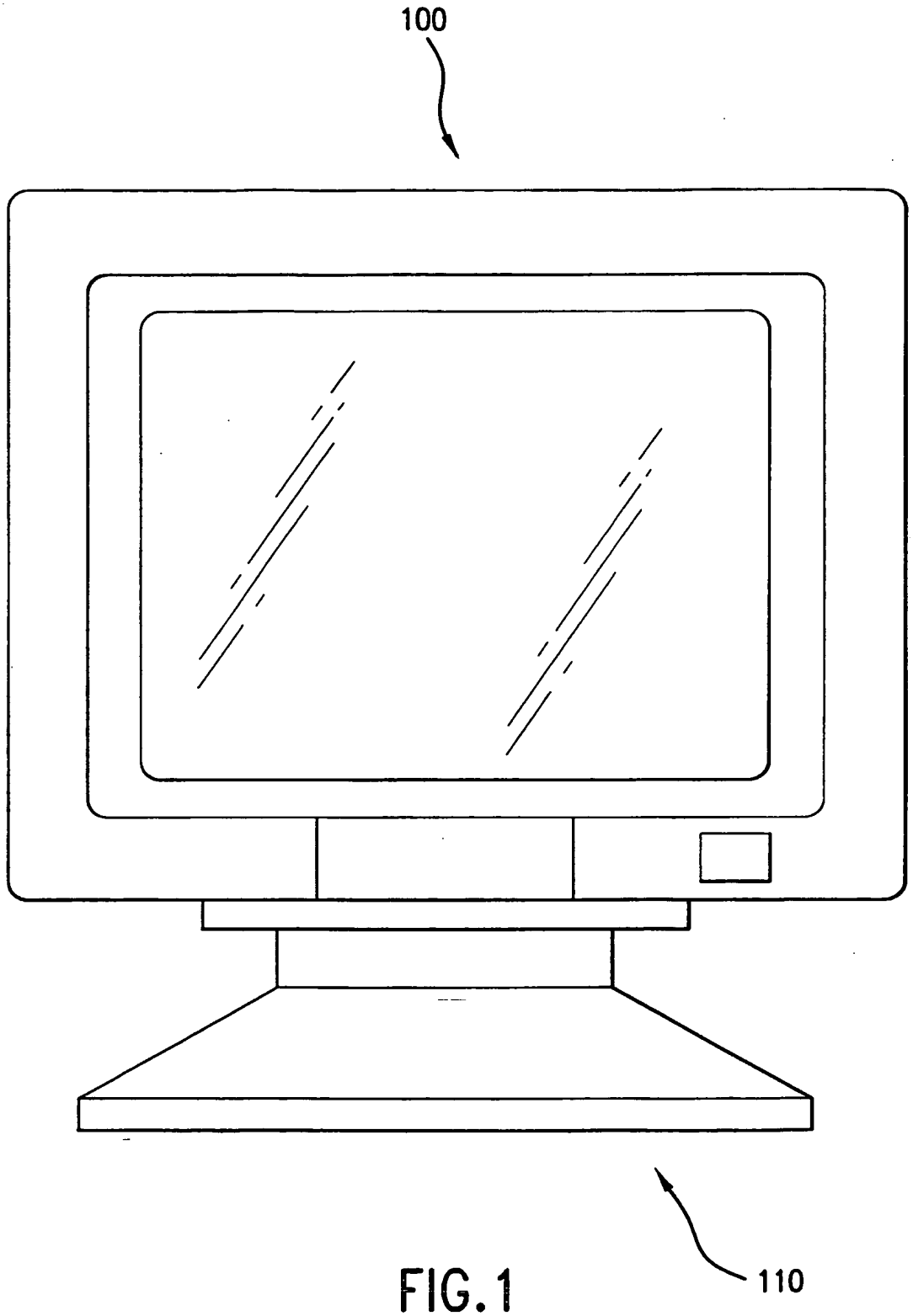

FIG. 1

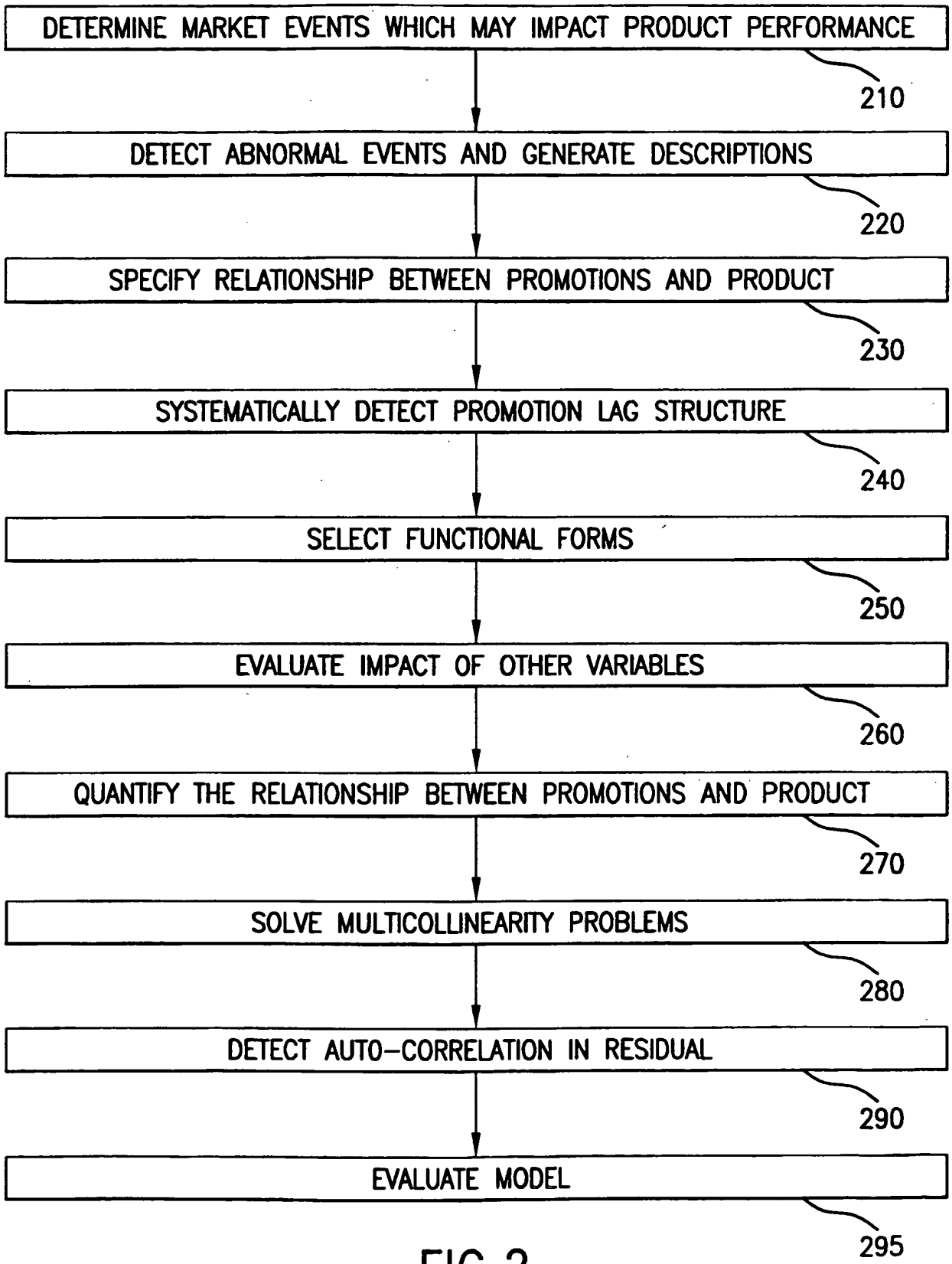
DETERMINE MARKET EVENTS WHICH MAY IMPACT PRODUCT PERFORMANCE
210
DETECT ABNORMAL EVENTS AND GENERATE DESCRIPTIONS
220
SPECIFY RELATIONSHIP BETWEEN PROMOTIONS AND PRODUCT
230
SYSTEMATICALLY DETECT PROMOTION LAG STRUCTURE
240
SELECT FUNCTIONAL FORMS
250
EVALUATE IMPACT OF OTHER VARIABLES
260
QUANTIFY THE RELATIONSHIP BETWEEN PROMOTIONS AND PRODUCT
270
SOLVE MULTICOLLINEARITY PROBLEMS
280
DETECT AUTO-CORRELATION IN RESIDUAL
290
EVALUATE MODEL
295

FIG.2

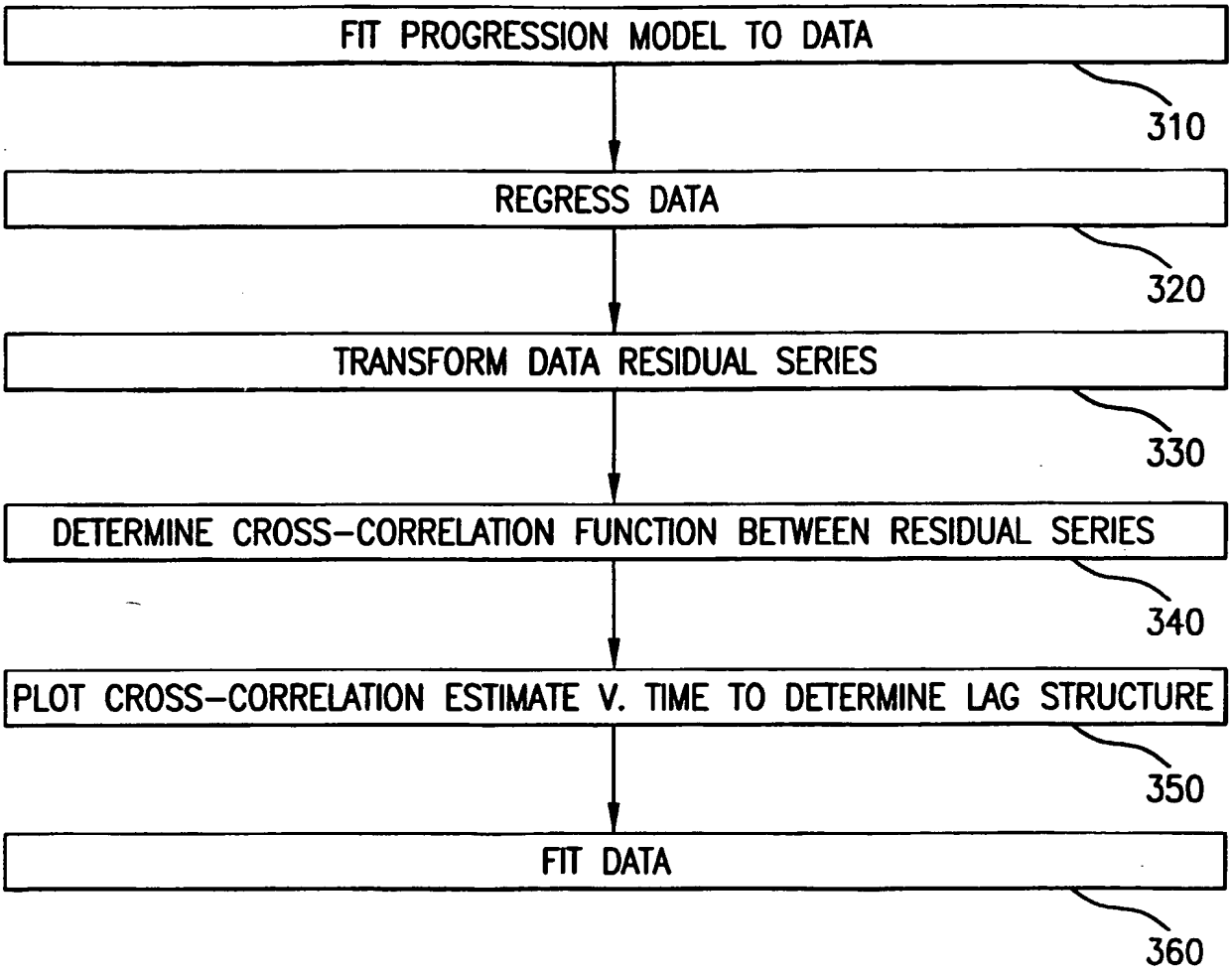
FIT PROGRESSION MODEL TO DATA
310
REGRESS DATA
320
TRANSFORM DATA RESIDUAL SERIES
330
DETERMINE CROSS-CORRELATION FUNCTION BETWEEN RESIDUAL SERIES
340
PLOT CROSS-CORRELATION ESTIMATE V. TIME TO DETERMINE LAG STRUCTURE
350
FIT DATA
360

FIG.3

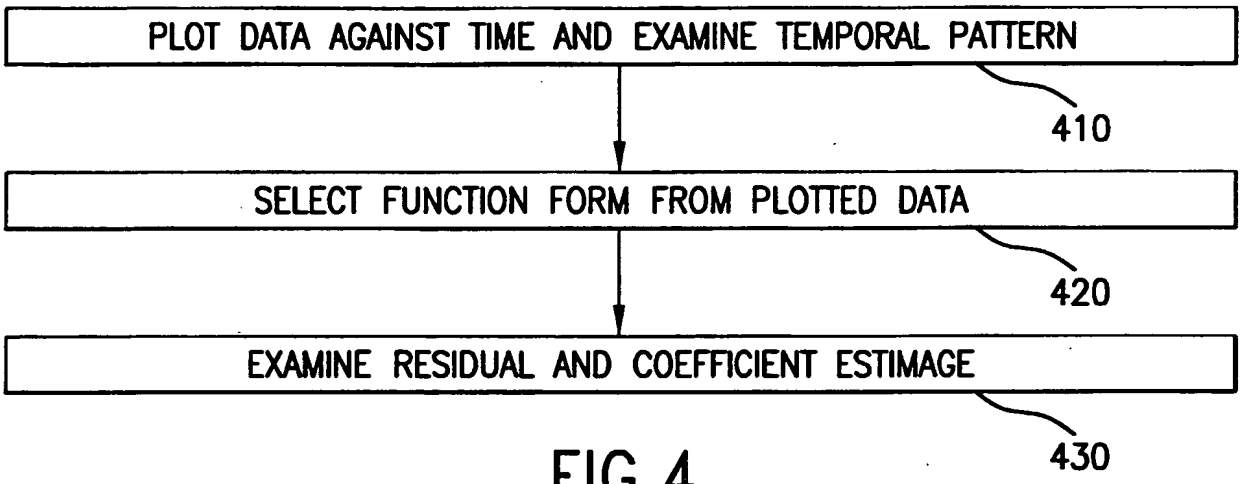
PLOT DATA AGAINST TIME AND EXAMINE TEMPORAL PATTERN
410
SELECT FUNCTION FORM FROM PLOTTED DATA
420
EXAMINE RESIDUAL AND COEFFICIENT ESTIMAGE
430

FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/26997

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G 06 F 17/60
US CL : 705/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

STN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	US 6,035,284 A (STRAUB et al) 07 March 2000, abstract, figure 1, figure 7b, column 1, lines 32-45	1-17
Y, P	US 6,029,139 A (CUNNINGHAM et al) 22 February 1999 abstract, figure 1, figure 2, column 1, lines 19-34, 59-63	1-17

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 29 NOVEMBER 2000	Date of mailing of the international search report 29 DEC 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JAMES TRAMMEL Telephone No. (703) 305-9768

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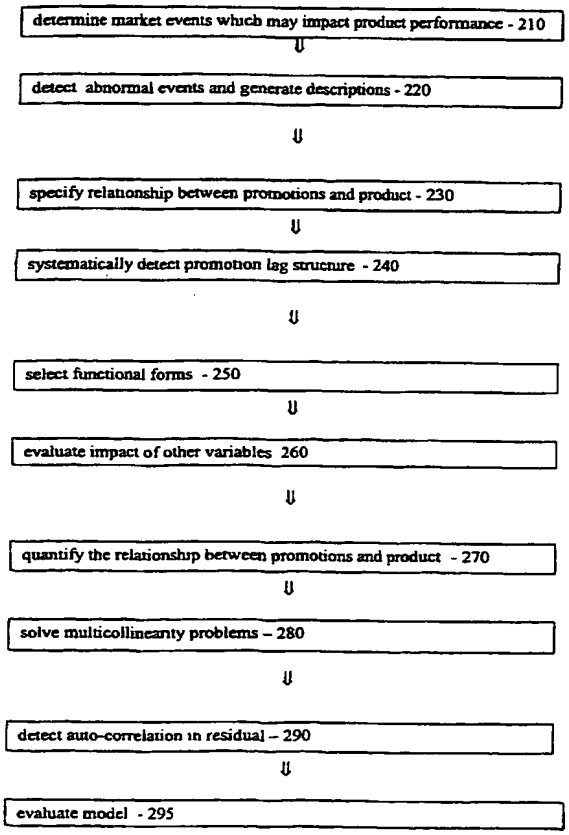
[Continued on next page]

(54) Title: A PROMOTIONAL IMPACT ASSESSMENT METHODOLOGY



(57) Abstract: Techniques for estimating the impact of one or more promotions on product performance for a product are disclosed. In a preferred embodiment, a method is presented which involves determining market events which may impact product performance. The market events are examined to detect any abnormal event and, if abnormal events are detected, generating a description for each detected for abnormal event. A relationship between each promotion and the product is then determined, and a promotion lag structure between the promotions and product performance is systematically detected (items 210, 220, 230, 240). Functional forms are selected to account for any impact of the determined market events which may impact product performance, and are evaluated to account for the determined market event. The relationship between the promotions and product performance is quantified by taking into account the selected functional forms (item 270).

WO 01/24094 A1

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

— *With international search report.*

A PROMOTIONAL IMPACT ASSESSMENT METHODOLOGY

SPECIFICATION

RELATED APPLICATION

The present application is based on U.S. provisional patent application serial number 60/157,139, filed September 30, 1999, from which priority is claimed.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is related to statistically measuring the impact of promotions on product sales, and more particularly, to techniques which employ time series analysis as part of an estimation methodology to determine such impact.

2. Related Art

Pharmaceutical companies spend billions of dollars each year to promote prescription drugs using various promotional vehicles. These include sales representatives detailing physicians about the information of their products and dropping free samples in doctors office, advertising in medical journals, continuing education programs for physician, and Direct-to-Consumer (DTC) advertising. With such financial and personnel investment, pharmaceutical companies need to measure the return on investment in prescription drug promotions. To do this, the impact of various promotions on product performance must be quantified.

Unfortunately, measuring the impact of promotions separately from other market inputs is not a simple task, as numerous factors may influence product performance. Moreover, it is well known that promotions have lagged effect, i.e., adverting activities in this month may increase prescription volume or market share for the product in next month, and the effect may last for several months. To accurately estimate the promotional effects, this lag structure must be evaluated. This is a very complicated problem because many forms of promotions may happen at the same time

and each of them may have different lag structure. Furthermore, the promotion lag structures vary across products and across therapeutic classes. The fact that many market inputs other than promotions, such as price, product attributes, and the entry of competitive products, may impact product performance further complicates the detection of the promotional lag structure.

Time series analysis is one well-known econometric tool that has been applied to study the relationship between advertising and sales. G. E. P. Box and G. M. Jenkins in their book, "Time Series Analysis: Forecasting and Control," San Francisco: Holden-Day, Inc. (1976), laid down the theoretical foundation of time series analysis and Box-Jenkins transfer function analysis. R. M. Helmer and J. K. Johansson applied the Box-Jenkins transfer function analysis to studying the advertising-sales relationship using a vegetable compound data, see "An Exposition of the Box-Jenkins Transfer Function Analysis With an Application to the Advertising-Sales Relationship," Journal of Marketing Research, 227-239 (1977). In their article, the procedural steps in applying the transfer function analysis technique are specified and applied to the sample advertising-sales data with particular focus on the advertising lag structure.

In the article "The Impact of a Direct-to-Consumer Prescription Medication Advertising Campaign on New Prescription Volume," Drug Information Journal, Vol. 30, 715-729 (1996), L. R. Basara used the new prescription data of a newly launched prescription drug and the Direct-to-Consumer advertising data constructed a time-series regression model with lagged sales and a first-order moving-average residual. However, the methodologies in these articles failed to account for other market events and market inputs such as competitive product launches, additional indications approved, and product price. In the book W. H. Greene, "Econometric Analysis," Prentice-Hall, Inc. (1997), a comprehensive discussion of different functional forms of lagged effect is provided. The disclosures of the Box et. al., Helmer et al., Basara and Greene references are incorporated by reference herein.

While the use of time series analysis techniques in assessment of the impact of advertising on product sales is discussed in each of the forgoing articles and books, none of the prior articles' or books' techniques disclose a methodology for systematically assessing the impact of promotional activity on product performance while

taking into account other market variables. Accordingly, there exists a need in the art for a broad and accurate promotional impact assessment technique.

SUMMARY OF THE INVENTION

An object of the present invention is to provide improved techniques for statistically measuring the impact of promotions on product sales.

A further object of the present invention is to provide improved techniques which employ time series analysis as part of an estimation methodology to determine the impact of promotions on product sales.

Yet another object of the present invention is to provide promotion response methodology for systematically assessing the impact of promotional activity on product performance while taking into account other market variables.

In order to achieve these objectives as well as others that will become apparent with reference to the following specification, the present invention provides techniques for estimating the impact of one or more promotions on product performance for a product are disclosed. In a preferred embodiment, a method is presented which involves determining market events which may impact product performance. The market events are examined to detect any abnormal event and, if abnormal events are detected, generating a description for each detected abnormal event. A relationship between each promotion and the product is then determined, and a promotion lag structure between the promotions and product performance is systematically detected. Functional forms are selected to account for any impact of the determined market events which may impact product performance, and are evaluated to account for the determined market event. The relationship between the promotions and product performance is quantified by taking into account the selected functional forms.

In one arrangement, the product is a pharmaceutical product, and the market event determining step involves manually determining one or more pharmaceutical market events which may impact pharmaceutical product performance. The abnormality examining step is then statistically determining whether any of the pharmaceutical market events is an abnormal event and, if one or more abnormal events are detected, generating statistical descriptions for each detected abnormal event.

In an especially preferred arrangement, the promotion lag detection step involves fitting a univariate auto-regressive model to each promotion to determine one or more promotion residual series, regressing performance information for the product to determine a product residual, transforming the product residual into a product residual series, determining one or more cross-correlation functions between the promotion residual series and product residual series, plotting the cross- correlation functions to detect any lagged effect from the promotions corresponding to those functions, and selecting appropriate functional form which best fit the plotted functions.

The accompanying drawings, which are incorporated and constitute part of this disclosure, illustrate a preferred embodiment of the invention and serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a functional diagram of a system in accordance with a preferred embodiment of the present invention;

Fig. 2 is a flow diagram illustrating the basic steps implemented in the system of Fig. 1;

Fig. 3 is a flow diagram illustrating the steps that may be implemented in one arrangement of a cross-correlation function useful in the system of Fig. 1; and

Fig. 4 is a flow diagram illustrating the steps that may be implemented in one arrangement of a functional form evaluation useful in the system of Fig. 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

In general, the present invention adapts and expands upon certain time series analysis techniques so that the impact of any promotional activities on product performance can be determined. In particular, cross-correlation functions are used to systematically detect promotion lag structure, and different functional forms are used to account for other market inputs in the model. While as exemplary embodiment of the present invention will be described herein to estimate the number of new prescriptions of a product that are attributable to DTC advertising, the approach has general applicability to study the impact of other forms of promotions such as professional detailing, sampling,

and medical journal advertising, continuing medical educational events and meetings on product sales.

The present invention applies to studying the promotional impact on increasing both primary and secondary demand. To determine the impact on primary demand, the prescription volume for the therapeutic class is used as the outcome variable. To determine the impact on secondary demand, product market share is used as the outcome variable.

Referring to Fig. 1, one preferred arrangement of the present invention requires the execution of several logical steps, each of which are discussed below. All steps may be performed either manually or on a system 100 including a computer 110 executing standard off the shelf statistical software, such SAS® or EViews. It should be noted that the following description is by way of example and not by limitation, with certain embodiments being described in order to best explain the principles of the present invention.

Referring next to Fig. 2, the logical steps implemented in the preferred arrangement will be described with reference to the flow diagram 200. In step 210, the market events that may impact product performance, such as the arrival of new approved indications, the launch of competitive products, any positive or negative publicity, policy changes and the like, are identified. This step may be performed manually by a research analyst who is familiar with the particular market in the pharmaceutical industry.

In step 220, any abnormalities in the data collected by the research analyst are detected, and descriptive statistics for each variable under study are generated. For example, off the shelf statistical software may be used to check the data collected by the data analyst to determine whether an abnormal number of prescriptions occurred in a time period to flag a probable human error. The descriptive statistics, such as the mean, standard deviation, minimum and maximum quantities are calculated for each of the variables under study. This step is required to ensure the quality of the data.

In step 230, the model structure of multiplicative or additive which reflects the relationships between promotions and product prescription data to be multiplicative or additive is specified by the research analyst. The research analyst may repeat the analysis for both multiplicative and additive model structures and then select the better

model based on the modeling fitting information, the reasonableness of the coefficients estimates, and model robustness to changes in specification.

In step 240, a cross-correlation function is used to systematically detect promotion lag structure. Referring to Fig. 3, a highly preferred arrangement of step 240 is further discussed.

First, an univariate auto-regressive model is fit to the promotion data "X" in 310, as fully described in the Box et al. article. This fitting is performed to remove the trend and seasonal components from the promotion variable. The model structure and the coefficients will be used in later steps. The residual series is called XX.

Second, the prescription data Y is regressed on variables which are known to have impact on product performance 320, such as trend, new product launch, new indication approved, and the like, to determine the residual of Y. Any standard multiple regression algorithm may be used, such as PROC REG in SAS®. This regression is implemented to remove the impact of other market events on the prescription data.

Third, the model structure and coefficients estimated from the first sub-step are used 330 to transform the residual series of prescription data Y generated in 320 to determine a new residual series, YY.

Fourth, the cross- correlation function between the residual series XX determined in 310 and the residual series YY determined in 330 is calculated 340. The detailed definition of cross-covariance and cross-correlation is fully described in the Box and Jenkins book which provides that the estimation of cross – covariance of Y and X is:

$$C_{XY}(k)=\frac{1}{N}\sum_{t=1}^{N-k}(X_t-\overline{X})(Y_{t+k}-\overline{Y})\ k=\ldots,-1,0,1,2,\ldots \qquad (1)$$

where t is the time period, N is total number of time periods, k is number of time periods between X and Y, $\overline{X}$ is the mean of X, $\overline{Y}$ is the mean of Y. The estimation of cross – correlation of Y and X is:

$$r_{XY}(k)=C_{XY}(k)/S_XS_Y \quad k=\ldots,-1,0,1,2,\ldots \qquad (2)$$

where

$$S_X=\sqrt{C_{XX}(0)} \text{ and } S_Y=\sqrt{C_{YY}(0)}$$

Fifth, $r_{xy}(k)$ is plotted on one axis and k on the other axis to plot the cross correlation function 350, which is examined to detect the initial lag and the length of lagged effect. The time period when the cross correlation function starts to increase/decrease is the time period the promotional effect starts, i.e. the initial lag. The time period when the cross correlation function reduces to a low level indicates the time period the promotion effect disappeared, the difference between the time period of the initial lag and the time period when the effect disappeared is the length of the promotion lagged effect. This provides an initial assessment of the lag structure.

Finally, different functional forms, such as the Polynomial Distributed Lag, or the Geometric distributed lag as described in the WH Greene reference, are fit to the data 360. The functional form which best fits the data is chosen by comparing the models, as well as the sign and significance of the coefficients of the variables in the models.

Returning to Fig. 2, in step 250, appropriate functional forms to account for other market events, such as new product launch, new indications approved, positive/negative publicity, etc., are evaluated. Referring to Fig. 4, a highly preferred arrangement of step 250 is further discussed.

First, the prescription data is plotted against time to examine the temporal pattern of the data 410. The data may be plotted using prescription data as the vertical axis and time as the horizontal axis.

Second, based on the plotted data, a functional form is selected 420. At the time of the market event under consideration, such as a new product launch or new indication approval, or shortly after, if the prescription data exhibits shift in trend, marked by a changing slope:

$$M(t) = \begin{cases} 0, & t < T \\ t, & t \geq T \end{cases} \qquad (3)$$

where T is the time of the market event, either M(t) is included as an independent variable in the model , or the interaction between M(t) and the trend variable is included as an independent variable in the model , with the model producing a smaller residual being selected.

Likewise, if the prescription data exhibits a jump, marked by a discontinuity:

$$M(t) = \begin{cases} 0, & t < T \\ 1, & t \geq T \end{cases} \quad (4)$$

either M(t) is included as an independent variable in the model , or the interaction between M(t) and the trend variable is included as an independent variable in the model , with the model producing a smaller residual being selected.

Finally, residual of the model and the coefficient estimate are examined 430 to determine whether the T is correctly specified. Since some market input may have lagged effect, a small integer such as 1, 2 or 3 may need to be added to T to account for the lag. A big residual at time T indicates a problematic model fit. The pattern of the residual will suggest the choice of the T. For example, if there are big residuals for two time periods after T, the T should increase by two time periods.

In step 260, the impact on prescription data of other variables such as product price, managed care impact, and the like, are evaluated, using the steps specified in step 240, by an analyst to determine whether the other variables are also impacting the prescription data and the lag structure.

In step 270, the multiplicative or additive models specified in step 230 are fit to quantify the relationship between prescription variables and promotion variables, and other market events and market inputs.

In step 280, multicollinearity problems between independent variables are checked. Some variables may have to be dropped due to the multicollinearity problem.

In step 290, the model residual is evaluated to detect any auto-correlation in residual. If there is auto-correlation in the residual, an autoregressive structure for the residual should be included in the model.

Finally, in step 295, the model is evaluated and validated to examine the stability and reasonableness of the model coefficients. For example, the model may be tested using the next several months of data to validate the model. The model estimates of the variables are applied to the next several months of data to compute sales, and are compared actual sales.

As described above, one advantage of the present invention is to combine econometric modeling techniques with transfer function analysis techniques in time series

analysis to detect the lag structure, and to quantify the effects of various promotions controlling for the impact of other factors. Using time series data of promotions and other key market inputs, this methodology can isolate and quantify promotional effects on products' prescription share and the total therapeutic class prescription volume. This methodology is applicable to measuring a wide range of promotional effects including DTC, professional detailing, sampling, and medical journal spending, and continuing medical educational events and meetings while controlling factors known to influence market share such as prescription price, competitive product launch, new indication approved, positive/negative publicity etc. Without accounting for the impact of these factors appropriately, it would not be possible to accurately measure the incremental prescriptions attributable to promotions.

Previous work done by Helmer and Johansson, and Basara applied the transfer function analysis to studying the promotional lagged effect, but failed to account for other market events and market inputs such as new product launches, new indications approved, positive/negative publicity, product price. As stated previously, this may result in inaccurate estimates of the promotional effects. Others accounted for some of the market inputs but relied on past experience and a "trail and error" approach to detect the promotional lag structure. The "trail and error" approach is time consuming and past experience may result in biased estimates because past experience may not be applicable to new promotional vehicles.

The foregoing merely illustrates the principles of the invention. Various modifications and alterations to the described embodiments will be apparent to those skilled in the art in view of the teachings herein. For example, this methodology may be modified to analyze the sales and promotions and other market inputs for consumer packaged goods. It will thus be appreciated that those skilled in the art will be able to devise numerous systems and methods which, although not explicitly shown or described herein, embody the principles of the invention and are thus within the spirit and scope of the invention.

CLAIMS

1. A method for estimating the impact of one or more promotions on product performance for a product, comprising the steps of:

a. determining one or more market events which may impact said product performance;

b. examining said determined one or more market events to detect any abnormal event and, if one or more abnormal events are detected; generating a description for each detected abnormal event;

c. determining a relationship between each of said one or more promotions and said product;

d. systematically detecting a promotion lag structure between said one or more promotions and said product performance for said product;

e. selecting one or more functional forms to account for any impact of each of said one or more determined market events which may impact said product performance;

f. evaluating each of said selected functional forms to account for said one or more determined market events, and

g. quantifying a relationship between said one or more promotions and said product performance for said product by taking into account said evaluated selected functional forms.

2. The method of claim 1, further comprising the step of checking for any multicollinearity problems between said one or more promotions, said product performance, and said evaluated selected functional forms.

3. The method of claim 2, wherein said relationship between said one or more promotions and said product performance includes a quantified portion and a residual portion, and further comprising the step of evaluating said residual portion to detect auto-correlation.

4. The method of claim 3, further comprising the step of evaluating and validating said quantified relationship.

5. The method of claim 1, wherein said product is a pharmaceutical product, and said market event determining step comprises manually determining one or more pharmaceutical market events which may impact said pharmaceutical product performance.

6. The method of claim 5, wherein said abnormality examining step comprises statistically determining whether any of said one or more pharmaceutical market events is an abnormal event and, if one or more abnormal events are detected; generating statistical descriptions for each detected abnormal event.

7. The method of claim 6, wherein said relationship determining step comprises determining a relationship between each of said one or more promotions and said product to be a relationship selected from the group consisting of multiplicative, additive, or other.

8. The method of claim 1, wherein said promotion lag detection step comprises:

(a) fitting a univariate auto-regressive model to each of said one or more promotions to determine one or more promotion residual series;

(b) regressing performance information for said product to determine a product residual;

(c) transforming said product residual into a product residual series;

(d) determining one or more cross- correlation functions between said one or more promotion residual series and said product residual series;

(e) plotting said one or more cross- correlation functions to detect any lagged effect from said one or more promotions corresponding to said one or more cross- correlation functions; and

(f) selecting one or more appropriate functional form which best fits said plotted functions.

9. The method of claim 1, wherein said functional form selection step comprises:

(a) plotting pharmaceutical product sales verses time to determine any temporal relationship; and

(b) selecting said functional form by examining said plotted data.

10. The method of claim 1, wherein said functional form evaluation step comprises graphical evaluation.

11. A system for estimating the impact of one or more predetermined promotions on product performance for a product by taking into account one or more predetermined market events which may impact said product performance, comprising:

a. means for examining said predetermined one or more market events to detect any abnormal event and for generating a description for each detected abnormal event, if any;

b. means for determining a relationship between each of said one or more predetermined promotions and said product;

c. means, responsive to said abnormality descriptions generated by said abnormality examining means and said determined relationships from said relationship determining means , for systematically detecting a promotion lag structure between said one or more promotions and said product performance for said product based on said abnormality descriptions and said determined relationships;

d. means, responsive to said predetermined market events , for selecting one or more functional forms to account for any impact of each of said one or more predetermined market events which may impact said product performance;

e. means, responsive to said selected functional forms generated by

said selection means, for evaluating each of said selected functional forms to account for said one or more determined market events, and

f. means, responsive to said detected promotion lag structure and evaluated selected functional forms, for quantifying a relationship between said one or more promotions and said product performance for said product by taking into account said promotion lag structure and evaluated selected functional forms.

12. The system of claim 11, further comprising means, responsive to said quantified relationships, for checking for any multicollinearity problems between said one or more promotions, said product performance, and said evaluated selected functional forms.

13. The system of claim 11, wherein said relationship between said one or more promotions and said product performance includes a quantified portion and a residual portion, and further comprising means, responsive to said quantified relationships, for evaluating said residual portion to detect auto-correlation.

14. The system of claim 11, further comprising means, responsive to said quantified relationships, for evaluating and validating said quantified relationship.

15. The system of claim 11, wherein said product is a pharmaceutical product, and said abnormality examining means includes means for statistically determining whether any of said one or more pharmaceutical market events is an abnormal event.

16. The system of claim 11, wherein said promotion lag detection means further includes:

(a) means for fitting a univariate auto-regressive model to each of said one or more promotions to determine one or more promotion residual series;

(b) means for regressing performance information for said product to determine a product residual;

(c) means, responsive to said product residual determined by said regressing performance means, for transforming said product residual into a

product residual series;

(d) means, responsive to said product residual series transformed by said transforming means and to said promotion residual series determined by said fitting means, for determining one or more cross- correlation functions between said one or more promotion residual series and said product residual series;

(e) means, responsive to said one or more cross- correlation functions determined by said cross-correlation function determining means, for plotting said one or more cross- correlation functions to detect any lagged effect from said one or more promotions corresponding to said one or more cross- correlation functions; and

(f) means, responsive to said plotting means, for selecting one or more appropriate functional form which best fits said plotted functions.

17. The system of claim 11, wherein said functional form selection means includes:

(a) means for plotting pharmaceutical product sales verses time to determine any temporal relationship; and

(b) means, responsive to said plotting means, for selecting said functional form by examining said plotted data.

FIGURE 1

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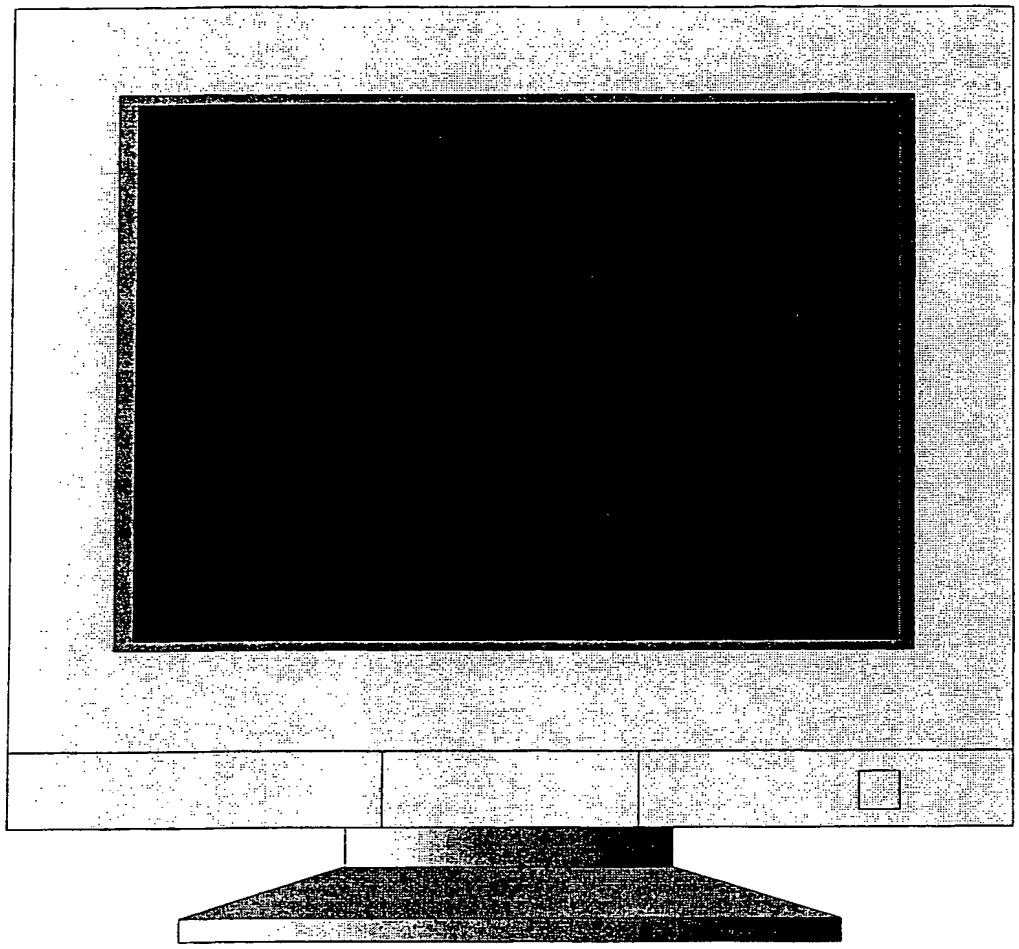


⇐ 110

FIGURE 2

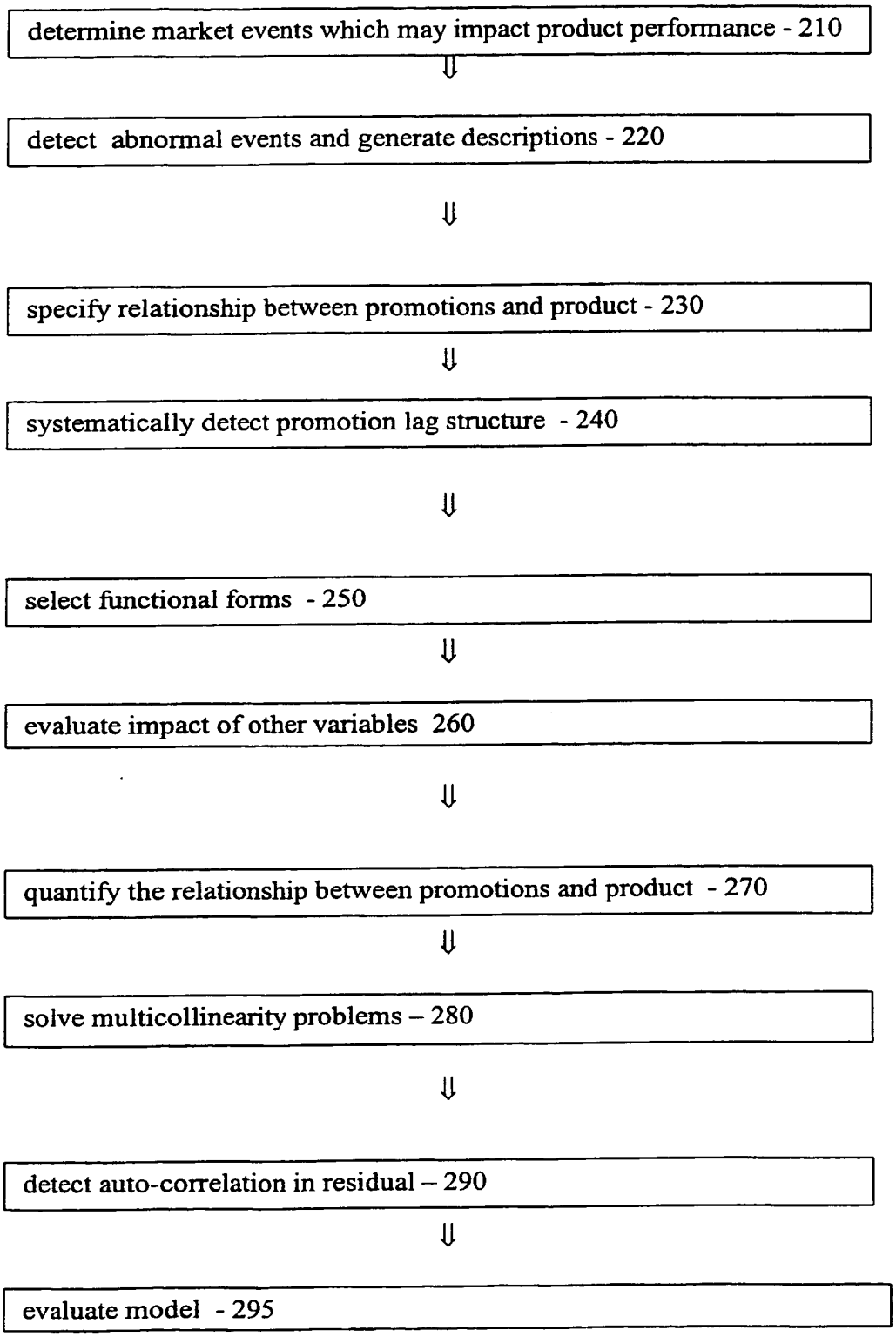

determine market events which may impact product performance - 210
detect abnormal events and generate descriptions - 220
specify relationship between promotions and product - 230
systematically detect promotion lag structure - 240
select functional forms - 250
evaluate impact of other variables 260
quantify the relationship between promotions and product - 270
solve multicollinearity problems – 280
detect auto-correlation in residual – 290
evaluate model - 295

FIGURE 3

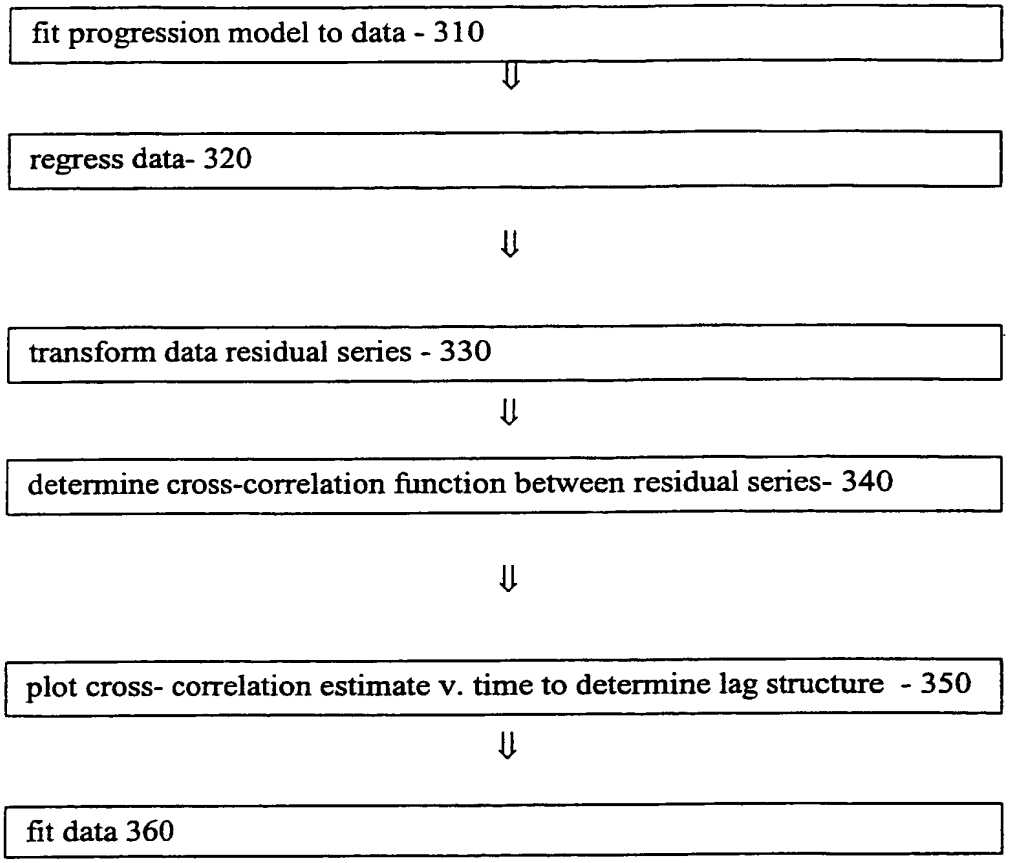
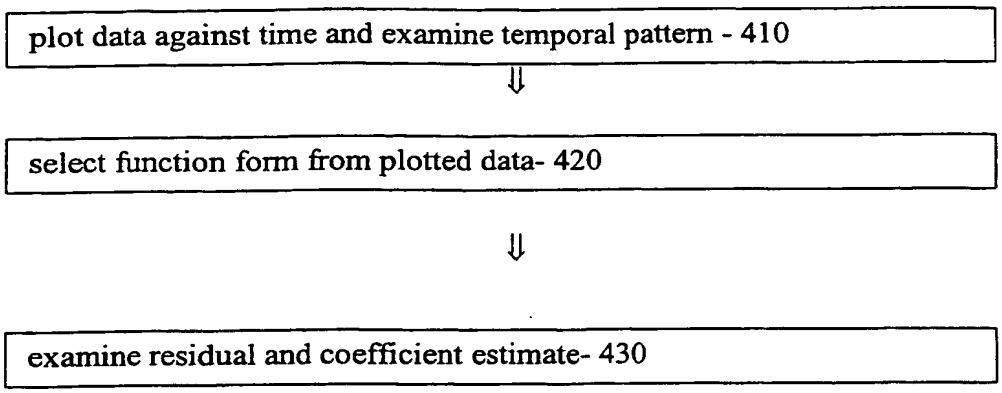

fit progression model to data - 310
regress data- 320
transform data residual series - 330
determine cross-correlation function between residual series- 340
plot cross- correlation estimate v. time to determine lag structure - 350
fit data 360

FIGURE 4


plot data against time and examine temporal pattern - 410
select function form from plotted data- 420
examine residual and coefficient estimate- 430

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/26997

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G 06 F 17/60
US CL : 705/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

STN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	US 6,035,284 A (STRAUB et al) 07 March 2000, abstract, figure 1, figure 7b, column 1, lines 32-45	1-17
Y, P	US 6,029,139 A (CUNNINGHAM et al) 22 February 1999 abstract, figure 1, figure 2, column 1, lines 19-34, 59-63	1-17

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 29 NOVEMBER 2000	Date of mailing of the international search report 29 DEC 2000
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Form PCT/ISA/210 (second sheet) (July 1998)*